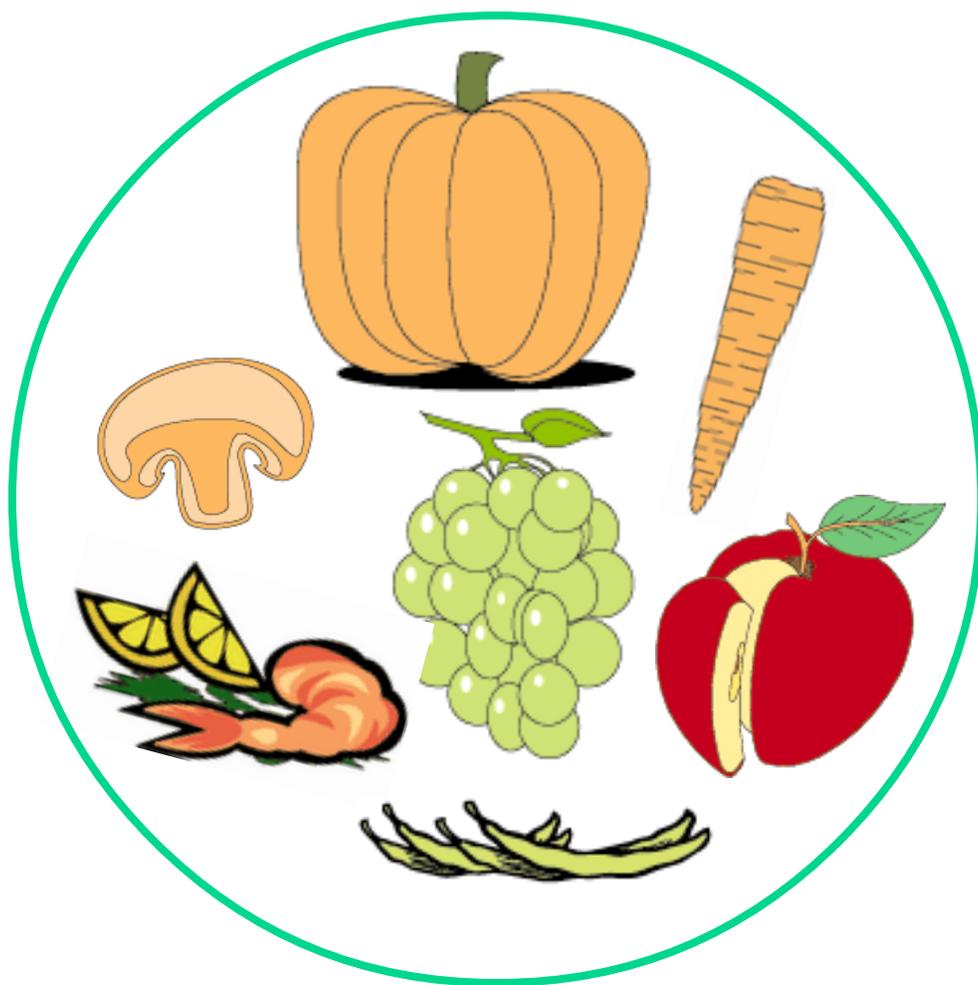


Food and Drug Administration Pesticide Program



Residue Monitoring 1997

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This is the eleventh annual report summarizing the results of the Food and Drug Administration's (FDA) pesticide residue monitoring program. Eight of the ten previous reports were published in the *Journal of the Association of Official Analytical Chemists / Journal of AOAC International*; these presented results from Fiscal Years (FY) 1987 through 1994. Results from FY 1995 and FY 1996 were published on FDA's World Wide Web site. This current report includes findings obtained during FY 1997 (October 1, 1996 through September 30, 1997) under regulatory and incidence/level monitoring. Selected Total Diet Study findings for 1997 are also presented. Results in this and earlier reports continue to demonstrate that levels of pesticide residues in the U.S. food supply are well below established safety standards.

FDA Monitoring Program

Three federal government agencies share responsibility for the regulation of pesticides. The Environmental Protection Agency (EPA) registers (i.e., approves) the use of pesticides and sets tolerances (the maximum amount of a residue that is permitted in or on a food) if use of that particular pesticide may result in residues in or on food (1). Except for meat, poultry, and certain egg products, for which the Food Safety and Inspection Service (FSIS) of the U.S. Department of Agriculture (USDA) is responsible, FDA is charged with enforcing tolerances in imported foods and in domestically produced foods shipped in interstate commerce. FDA also acquires incidence/level data on particular commodity/pesticide combinations and carries out its market basket survey, the Total Diet Study. Since 1991, USDA's Agricultural Marketing Service (AMS), through contracts with participating states, has carried out a residue testing program directed at raw agricultural products and various processed foods. FSIS and AMS report their pesticide residue data independently.

Regulatory Monitoring

Under this approach to pesticide residue monitoring, FDA samples individual lots of domestically produced and imported foods and analyzes them for pesticide residues to enforce the tolerances set by EPA. Domestic samples are collected as close as possible to the point of production in the distribution system; import samples are collected at the point of entry into U.S. commerce. Emphasis is on the raw agricultural product, which is analyzed as the unwashed, whole (unpeeled), raw commodity. Processed foods are also included. If illegal residues (above EPA tolerance or no tolerance for that particular food/pesticide combination) are found in domestic samples, FDA can invoke various sanctions, such as a seizure or injunction. For imports, shipments may be stopped at the port of entry when illegal residues are found. "Detention without physical examination" (previously called automatic detention) may be invoked for imports based on the finding of one violative shipment if there is reason to believe that the same situation will exist in future lots during the same shipping season for a specific shipper, grower, geographic area, or country.

Domestic and import food samples collected are classified as either "surveillance" or "compliance". Most samples collected by FDA are the surveillance type; that is, there is no prior knowledge or evidence that a specific food shipment contains illegal pesticide residues. Compliance samples are taken as follow-up to the finding of an illegal residue or when other evidence indicates that a pesticide residue problem may exist.

Factors considered by FDA in planning the types and numbers of samples to collect include review of recently generated state and FDA residue data, regional intelligence on pesticide use, dietary importance of the food, information on the amount of domestic food that enters interstate commerce and of imported food, chemical characteristics and toxicity of the pesticide, and production volume/pesticide usage patterns.

Analytical Methods

To analyze the large numbers of samples whose pesticide treatment history is usually unknown, FDA uses analytical methods capable of simultaneously determining a number of pesticide residues. These multiresidue methods (MRMs) can determine about half of the approximately 400 pesticides with EPA tolerances, and many others that have no tolerances. The most commonly used MRMs can also detect many metabolites, impurities, and alteration products of pesticides (2).

Single residue methods (SRMs) or selective MRMs are used to determine some pesticide residues in foods (2). An SRM usually determines one pesticide; a selective MRM measures a relatively small number of chemically related pesticides. These types of methods are usually more resource-intensive per residue. Therefore, they are much less cost effective than MRMs.

The lower limit of residue measurement in FDA's determination of a specific pesticide is usually well below tolerance levels, which generally range from 0.1 to 50 parts per million (ppm). Residues present at 0.01 ppm and above are usually measurable; however, for individual pesticides, this limit may range from 0.005 to 1 ppm. In this report, the term "trace" is used to indicate residues detected, but at levels below the limit of quantitation (LOQ).

FDA/State Cooperation

Personnel in FDA field offices interact with their counterparts in many states to increase FDA's effectiveness in pesticide residue monitoring. In many cases, Memoranda of Understanding or more formal Partnership Agreements have been established between FDA and various state agencies. These agreements provide for more efficient monitoring by broadening coverage and eliminating duplication of effort, thereby maximizing federal and state resources allocated for pesticide activities. These arrangements vary from data sharing, joint planning, and state collection of samples for FDA examination, to FDA/State division of collection, analytical, and enforcement follow-up responsibilities for individual commodities or products of particular origin (i.e., imported vs. domestic products).

Animal Feeds

In addition to monitoring foods for human consumption, FDA also samples and analyzes domestic and imported feeds for pesticide residues. FDA's Center for Veterinary Medicine (CVM) directs this portion of the Agency's monitoring via its Feed Contaminants Compliance Program. Although animal feeds containing violative pesticide residues may present a potential hazard to a number of different categories of animals (e.g., laboratory animals, pets, wildlife, etc.), the major focus of CVM's monitoring is on feeds for livestock and poultry, animals that ultimately become, or produce, foods for human consumption.

International Activities

FDA participates in several international agreements in an effort to minimize incidents of violative residues and remove trade barriers. A standing request for information from foreign governments on pesticides used on their food exported to the U.S. exists, a provision of the Pesticide Monitoring Improvements Act.

Under the auspices of the North American Free Trade Agreement (NAFTA), the United States, Mexico, and Canada have established a NAFTA Technical Working Group on Pesticides (TWG). The NAFTA Pesticide TWG now serves as the focal point for all pesticide issues that arise among the three NAFTA countries. The TWG reports directly to the NAFTA Sanitary and Phytosanitary Committee.

One of the major goals of the TWG is to ensure that pesticide registrations and tolerances/maximum residue limits in the three countries are harmonized to the extent practical, while strengthening protection of public health and the environment. A number of projects have been undertaken by the TWG to identify differing residue limits in the NAFTA countries and to determine what steps might be taken to harmonize

the limits. While this is a difficult process, the TWG envisions eventual movement toward a “North America” pesticide registration and tolerance system so that citizens of all three countries can be assured of the safety and legality of foods produced in any one of the NAFTA countries. FDA’s activities on the TWG complement its ongoing bilateral cooperation with its counterparts in Mexico and Canada.

Beyond the North American agreements, FDA continues to collaborate with New Zealand to implement a “residue compliance assurance program.” New Zealand, historically having excellent compliance with U.S. pesticide tolerances, is implementing a plan whereby their government would provide assurances that selected commodities exported to the United States would be in full compliance with U.S. tolerances.

Total Diet Study

The Total Diet Study is the other major element of FDA’s pesticide residue monitoring program (3). In its previous annual pesticide reports, FDA provided Total Diet Study findings for 1987-1996 (4a, 4b). More detailed information, including estimated dietary intakes of pesticide residues covering June 1984-April 1986 (5) and July 1986-April 1991 (6), has been published. In September 1991, FDA implemented revisions to the Total Diet Study that were formulated in 1990 (7). These revisions primarily consisted of collection and analysis of an updated and expanded number of food items, addition of six age/sex groups (for a total of 14), and revised analytical coverage. Details of that revision are published (8, 9).

In conducting the Total Diet Study, FDA personnel purchase foods from supermarkets or grocery stores four times per year, once from each of four geographic regions of the country. The 261 foods that comprise each market basket represent over 3500 different foods reported in USDA food consumption surveys; for example, apple pie represents all fruit pies and fruit pastries. Each collection is a composite of like foods purchased in three cities in a given region. The foods are prepared table-ready and then analyzed for pesticide residues (as well as radionuclides, industrial chemicals, toxic elements, trace and macro elements, vitamin B6, and folic acid). The levels of pesticides found are used in conjunction with USDA food consumption data to estimate the dietary intakes of the pesticide residues.

Results and Discussion

Regulatory Monitoring

In 1997, 9,843 samples (9,652 surveillance and 191 compliance) were analyzed under regulatory monitoring. Of these, 4,501 were domestic and 5,342 were imports.

Figure 1 shows the percentage of the 4,429 domestic surveillance samples by commodity group with no residues found, nonviolative residues found, and violative residues found. (A violative residue is defined in this report as a residue which exceeds a tolerance or a residue at a level of regulatory significance for which no tolerance has been established in the sampled food.)

As in earlier years, fruits and vegetables accounted for the largest proportion of the commodities analyzed in 1997; those two commodity groups comprised 65% of the total number of domestic surveillance samples. In 1997, no violative residues were found in 98.8% of all domestic surveillance samples (98.7% in 1995 and 99.1% in 1996).

Appendix A contains more detailed data on domestic surveillance monitoring findings by commodity, including the total number of samples analyzed, the percent samples with no residues found, and the percent violative samples. Of the 4,429 domestic surveillance samples, 66.0% had no detectable residues and 1.24% had violative residues. In the largest commodity groups, fruits and vegetables, 44.1% and 69.1% of the samples, respectively, had no residues detected. 1.2% of the fruit samples and 2.4% of the vegetable samples contained violative residues (Figure 1). In the milk/dairy products/eggs group, 97.0% of the samples had no residues detected, and no violative residues were found. Fifty-one samples of baby foods or formula were analyzed (see category Other). This included 17 vegetable, 12 cereal, 18 fruit juice, and 4 formula samples. None of the samples had violative residues.

Figure 1. Summary of Results of Domestic Surveillance Samples by Commodity

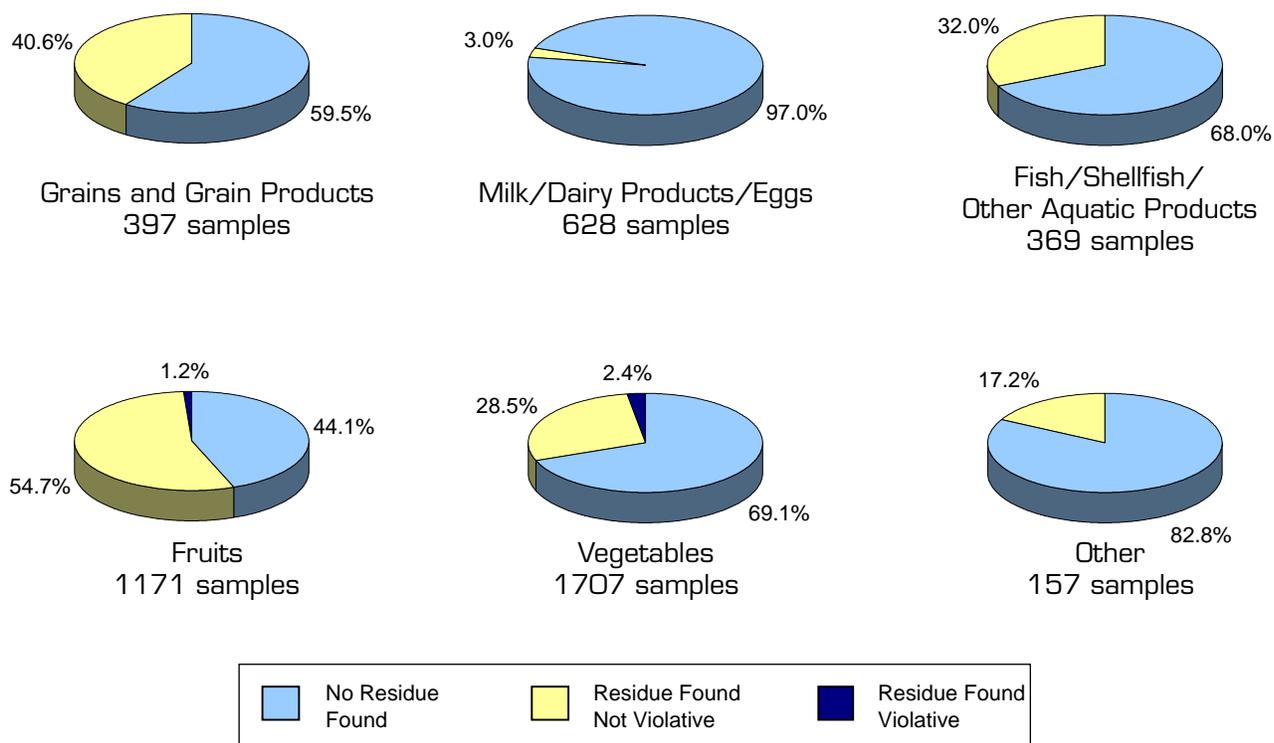
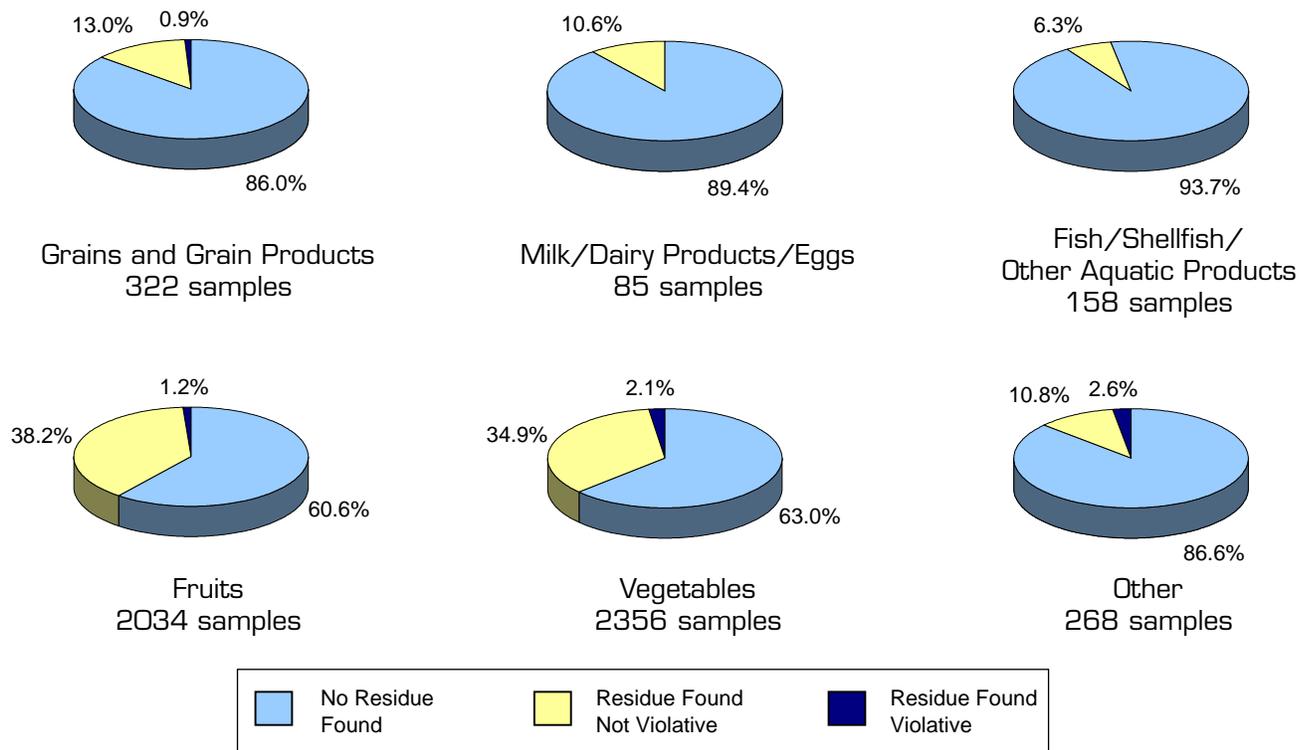


Figure 2. Summary of Results of Import Surveillance Samples by Commodity



Findings by commodity group for the 5,223 import surveillance samples are shown in Figure 2. Fruits and vegetables accounted for 84.1% of these samples. Overall, no violative residues were found in 98.4% of the import surveillance samples (96.8% in 1995 and 97.4% in 1996).

Appendix B contains detailed data on the import surveillance samples. Of the 5,223 samples analyzed, 66.1% had no residues detected, and less than 2% had violative residues. Fruits and vegetables had 60.6 and 63.0%, respectively, with no residues detected. The fruit group and the vegetable group had 1.2 and 2.1%, respectively, with violative residues. No residues were found in 89.4% of the dairy products/eggs group and 96.7% of the fish/shellfish group, and no violative residues were found in either of those groups.

Pesticide monitoring data collected under FDA's regulatory monitoring approach in 1997 are available to the public as a computer database. This database summarizes FDA 1997 regulatory monitoring coverage and findings by country/commodity/pesticide combination. The database also includes the monitoring data by individual sample from which the summary information was compiled. Information on how to obtain this database as well as those for 1992-1996 is provided at the end of this report.

Geographic Coverage

Domestic. In 1997, the 4,429 domestic surveillance samples were collected from all 50 states, Puerto Rico and American Samoa. The largest numbers of samples were collected from those states that are the largest producers of fruits and vegetables. Table 1 lists numbers of domestic surveillance samples from each location, in order of descending numbers of samples.

Table 1. Domestic Surveillance Samples Collected and Analyzed, by State^a, in 1997

<u>State</u>	<u># samples</u>						
CA	632	TX	96	SD	41	OK	20
FL	514	MN	93	AR	34	WY	17
WA	388	GA	63	SC	34	WV	13
NY	273	MI	62	CO	32	IN	11
VA	203	NJ	62	TN	31	AK	10
LA	198	MD	59	IA	28	RI	7
AZ	149	OH	57	UT	27	ME	6
IL	144	MT	56	AL	26	NH	6
OR	141	KS	46	DE	25	HI	5
MO	139	ND	45	NE	25	NV	4
ID	130	NC	44	KY	21	CT	3
MA	129	MS	42	NM	21	VT	1
WI	113	PA	41				

^aOther domestic samples: Puerto Rico, 52 samples; American Samoa, 10 samples.

Import. Samples representing food shipments from 97 countries were collected. (Origin of some additional samples was unspecified.) Table 2 lists numbers of samples (surveillance and compliance) collected from each country. Mexico, as usual, was the source of the largest number of samples, reflecting the volume and diversity of commodities imported from that country, especially during the winter months.

Table 2. Foreign Countries and Number of Samples^a Collected and Analyzed in 1997

Mexico	2056	Israel	44
Chile	314	Argentina	43
China, Peoples Rep.	207	Honduras	40
Guatemala	190	Belgium	39
Thailand	185	Unspecified	39
Canada	164	South Africa	38
Ecuador	162	Philippines	35
Italy	143	Greece	34
Netherlands (Holland)	142	Jamaica	34
Spain (including Canary Islands)	130	Brazil	28
India	117	Indonesia	26
Colombia	110	Viet-Nam, Rep. Of	25
Costa Rica	106	United Kingdom	24
Dominican Republic	92	Japan	18
Turkey	74	El Salvador	17
Taiwan, Republic Of	71	Germany, Federal Rep	16
New Zealand	66	Pakistan	16
Korea, Rep. Of (South Korea)	60	Hong Kong	14
Panama	60	Egypt	13
Peru	56	Poland	13
France	51	Denmark	11
Australia	48		

Ten or fewer samples collected from the following:

Austria	Fiji	Lebanon	Singapore
Bahamas	Finland	Macedonia	Slovenia
Bangladesh	Ghana	Malawi	St. Lucia
Belize	Greenland	Malaysia	Sweden
Bolivia	Grenada	Moldova (Moldavia)	Switzerland
Br. Virgin Is.	Guadeloupe	Morocco	Trinidad & Tobago
Bulgaria	Guyana	Mozambique	Tunisia
Burma (Myanmar)	Haiti	Namibia (Southwest A	Ukraine
Congo	Hungary	Nicaragua	Uruguay
Croatia	Iceland	Nigeria	Uzbekistan
Cyprus	Ireland	Norway	Venezuela
Czech Republic	Ivory Coast	Oman (Muscat)	Yugoslavia
Estonia	Kenya	Portugal (inc. Azores)	Zambia
Ethiopia	Korea, Dem. Peoples	Russia	

^a Surveillance plus compliance samples.

Surveillance/Compliance Violation Rate Comparison

In 1997, 72 domestic and 119 import compliance samples were collected and analyzed (Table 3). Because compliance samples are collected when a pesticide residue problem is known or suspected, violation rates are expectedly higher than those for surveillance samples: 6.9% for domestic (7.8% in 1996) and 10.1% for imports (11.5% in 1996). The corresponding violation rates for surveillance samples were 1.2% for domestic and 1.6% for imports.

Most of the 1997 compliance samples were collected as follow-up to violative surveillance samples. These included follow-up samples from the same shipment as the violative surveillance sample, follow-up samples of the same commodity from the same grower or shipper, and audit samples from shipments presented for entry into the United States with a certificate of analysis (i.e., shipments subject to detention without physical examination).

Table 3. Compliance Samples by Commodity Group in 1997

<u>Commodity Group</u>	<u>Total No. of Samples</u>	<u>Samples without Residues, %</u>	<u>Samples Violative, %</u>
Domestic			
Grains and Grain Products	3	66.7	0.0
Milk/Dairy Products/Eggs	7	85.7	0.0
Fish/Shellfish/ Other Aquatic Products	3	33.3	0.0
Fruits	6	0.0	0.0
Vegetables	45	31.1	11.1
Other	8	87.5	0.0
Total	72	41.7	6.9
Import			
Grains and Grain Products	15	66.7	0.0
Milk/Dairy Products/Eggs	2	100.0	0.0
Fish/Shellfish/ Other Aquatic Products	3	100.0	0.0
Fruits	18	55.6	11.1
Vegetables	64	51.6	15.6
Other	17	76.5	0.0
Total	119	59.7	10.1

Pesticide Coverage

Table 4 lists the 366 pesticides that were detectable by the methods used; each of the 91 pesticides that were actually found is indicated by an asterisk.

FDA conducts ongoing research to expand the pesticide coverage of its monitoring program. This research includes testing the behavior of new or previously untested pesticides through existing analytical methods, and development of new methods to cover pesticides that cannot be determined by methods currently used by FDA. The research encompasses both U.S.-registered pesticides and foreign-use pesticides that are not registered in the United States. The list of pesticides detectable for 1997 (Table 4) reflects the addition of a number of pesticides whose recovery through the analytical methods used was demonstrated as a result of ongoing research.

Table 4. Pesticides Detectable and Found () by Methods Used in 1997 Regulatory Monitoring^{a,b}*

2,4-dichloro-6-nitro benzenamine	butachlor	cyanofenphos	dinocap
4(phenylamino)phenol*	butralin	cyanophos	dioxabenzofos
acephate*	butylate	cycloate	dioxacarb
acetochlor	cadusafos	cycluron	dioxathion
acrinathrin	captafol	cyfluthrin	diphenamid
alachlor	captan*	cymoxanil	diphenylamine*
aldicarb*	carbaryl*	cypermethrin*	dipropetryn
aldrin	carbofuran	cyprazine	disulfoton*
allethrin	carbophenothion	cyproconazole	diuron
allidochlor	carbosulfan	cyprodinil	edifenphos
alpha-cypermethrin	carboxin	DCPA*	endosulfan*
ametryn	carfentrazone ethyl ester	DDT*	endrin*
aminocarb	chlorbenside	deltamethrin	EPN
amitraz	chlorbromuron	deltamethrin, trans	esfenvalerate*
anilazine	chlorbufam	demeton*	etaconazole
Aramite	chlorbdane*	desmetyrn	ethalfluralin
atrazine*	chlordecone	dialifor	ethephon
azinphos-ethyl	chlor dimeform*	di-allate	ethiofencarb
azinphos-methyl*	chlor ethoxyfos	N,N-diallyl-dichloro= acetamide	ethion*
bendiocarb	chlorfenapyr	diazinon*	ethofumesate
benfluralin	chlorfenvinphos	dichlobenil	ethoprop
benodanil	chlorflurecol methyl ester	dichlofenthion	ethoxyquin*
benoxacor	chlorimuron ethyl ester	dichlofluanid*	ethylenebisdithio= carbamates ^d
bensulide	chlornitrofen	dichlone	etridiazole
benzoylprop-ethyl	chlorobenzilate	4-(dichloroacetyl)-1-oxa- 4-azapiro[4.5]decane	etrimfos*
6-benzyladenine	3-chloro-5-methyl-4- nitro-1H-pyrazole	2,6-dichlorobenzamide	famphur
BHC*	chloroneb	dichlorvos*	fenamiphos
bifenoxy	chloropicrin	diclobutrazol	fenarimol
bifenthrin*	chloropropylate	diclofop-methyl	fenbuconazole
binapacryl	chlorothalonil*	dicloran*	fenfuram
biphenyl*	chloroxuron	dicofol*	fenitrothion
bitertanol	chlorpropham*	dicrotophos	fenoxaprop ethyl ester
bromacil	chlorpyrifos*	dieldrin*	fenoxycarb
bromophos	chlorpyrifos-methyl*	diethyl-ethyl	fenpropathrin*
bromophos-ethyl	chlorthiophos	Dilan	fenpropimorph
bromopropylate	clomazone	dimethachlor	fenson
bromoxynil	coumaphos	dimethametryn	fensulfothion
bromuconazole	crotoxyphos	dimethipin	fenthion
bufencarb	crufomate	dimethoate*	fenvalerate*
Bulan	cyanazine	dinitramine	fipronil
bupirimate		dinobuton	flamprop-M-isopropyl
			flamprop-methyl

^a The list of pesticides detectable is expressed in terms of the parent pesticide. However, monitoring coverage and findings may have included metabolites, impurities, and alteration products.

^b Some of these pesticides are no longer manufactured or registered for use in the United States.

^c The analytical methodology determines carbendazim, which may result from use of benomyl or carbendazim.

^d Such as maneb.

Table 4 (continued)

fluazifop butyl ester	methomyl*	Perthane	simetryn
fluchloralin	methoprotryne	phenmedipham*	Strobane
flucythrinate	methoxychlor*	phenothrin	sulfallate
fludioxinil	2-methoxy-5,6-	phenthoate	sulfotep*
flusilazole	trichloropyridine	phenylphenol, ortho-*	Sulphenone
fluvalinate*	methyl chloride*	phorate*	sulprofos
folpet*	metobromuron	phosalone*	TCMTB
fonofos	metolachlor	phosmet*	tebuconazole
formothion	metolcarb	phosphamidon*	tebupirimfos
fosthiazate	metribuzin	phoxim oxygen analog	tecnazene
fuberidazole	mevinphos*	piperonyl butoxide	tefluthrin
furilazole	MGK 264	piperophos	TEPP
Gardona	mirex	pirimicarb	terbacil
heptachlor*	molinate	pirimiphos-ethyl	terbufos
heptenophos	monocrotophos*	pirimiphos-methyl*	terbumeton
hexachlorobenzene*	monolinuron	pretilachlor	terbuthylazine
hexaconazole	monuron	probenazole	terbutryn
hexazinone	myclobutanil*	prochloraz	tetradifon
hexythiazox	naled*	procylazine	tetraiodoethylene
imazalil*	napropamide	procymidone*	tetrasul
imazamethabenz	naptalam*	prodiamine	thiabendazole*
methyl ester	neburon	profenofos	thiazopyr
iprobenfos	nitralin	profluralin	thiodicarb
iprodione*	nitrapyrin	Prolan	thiometon
iprodione metabolite	nitrofen	promecarb	thionazin
isomer*	nitrofluorfen	prometryn	thiophanate-methyl
isazofos	nitrothal-isopropyl	pronamide	THPI*
isocarbamid	norea	propachlor	tolyfluanid
isofenphos	norflurazon	propanil	toxaphene
isoprocarb	nuarimol	propargite*	tralomethrin
isopropalin	octhiline	propazine	traloxymdim
isoprothiolane	ofurace	propetamphos	triadimefon*
isoxaben	omethoate*	propham	triadimenol*
isoxaflutole	ovex	propiconazole	tri-allate
lactofen	oxadiazon	propoxur*	triazamate
lambda-cyhalothrin	oxadixyl	prothiofos	triazophos
lenacil	oxamyl*	prothoate	tribufos*
leptophos	oxydemeton-methyl	pyracarbolid	trichlorfon
lindane*	oxyfluorfen	pyrazon	tricyclazole
linuron*	oxythioquinox	pyrazophos*	tridiphane
malathion*	paclobutrazol	pyrethrins	trietazine
mecarbam*	paraquat	pyridaphenthion	triflumizole
mephosfolan	parathion*	pyrimethanil	trifluralin*
merphos	parathion-methyl*	pyriproxyfen	triflusaluron methyl
metalaxyl*	pebulate	quinalphos*	ester
metaldehide*	penconazole	quintozene*	trimethacarb
metasystox thiol	pendimethalin	quizalofop ethyl ester	vamidothion sulfone
metazachlor	pentachlorobenzene*	ronnel	vernolate
methabenzthiazuron	pentachlorobenzonitrile	S-bioallethrin	vinclozolin*
methamidophos*	pentachlorophenyl	schradan	XMC
methidathion*	methyl ether*	secbumeton	
methiocarb*	permethrin*	simazine*	

Animal Feeds

In FY97, 460 domestic and 42 import feed samples were collected for surveillance purposes and analyzed for pesticides by the FDA. Of the 460 domestic surveillance samples, 286 (62.2%) contained no detectable pesticide residues and 1 (0.2%) contained residues which exceeded regulatory guidance (Table 5). Of the 42 import surveillance samples, 24 (57.1%) contained no detectable pesticide residues and 1 (2.4%) contained residues which exceeded regulatory guidance.

A domestic sample of sudan hay contained 0.170 ppm of endosulfan sulfate and an imported sample of canola fines contained 0.033 ppm of malathion. These two samples were considered to have exceeded regulatory guidance because there are no tolerances established for these pesticide/commodity combinations.

In the 174 domestic surveillance samples of feed in which one or more pesticides were detected, there were 259 residues (193 quantifiable and 66 trace). Malathion, chlorpyrifos-methyl, and diazinon were the most frequently found and accounted for 71.4% of all residues detected (Table 6).

Table 5. Summary of 1997 Domestic Surveillance Feed Samples

Type of Feed	Total	Without residues		Exceeding Guidance	
	# Samples	#	%	#	%
Whole/Ground Grains	167	118	70.7	0	0.0
Mixed Feed Rations	102	40	39.2	0	0.0
Animal By-products	91	62	68.1	0	0.0
Plant By-products	80	50	62.5	0	0.0
Hay & Hay Products	19	15	78.9	1	5.3
Minerals/Supplements	1	1	100.0	0	0.0
Total	460	286	62.2	1	0.2

Table 6. Residues Found in Feeds in 1997

Pesticide	# of Samples with		Range ^b (ppm)	Median ^b (ppm)
	Trace Amount ^a	Quantifiable Levels		
malathion	25	81	0.010–3.180	0.060
chlorpyrifos-methyl	8	38	0.010–2.420	0.064
diazinon	6	27	0.010–0.160	0.030
DEF	2	13	0.050–0.600	0.115
chlorpyrifos	7	4	0.012–0.434	0.064
parathion	1	7	0.020–0.440	0.135
methoxychlor	3	5	0.017–0.145	0.025
ethion	3	3	0.029–0.110	0.080
all others ^c	11	15	0.010–235.0 ^d	0.075

^a residue found is below that normally quantifiable, but its presence and identity are known.

^b in samples containing quantifiable levels.

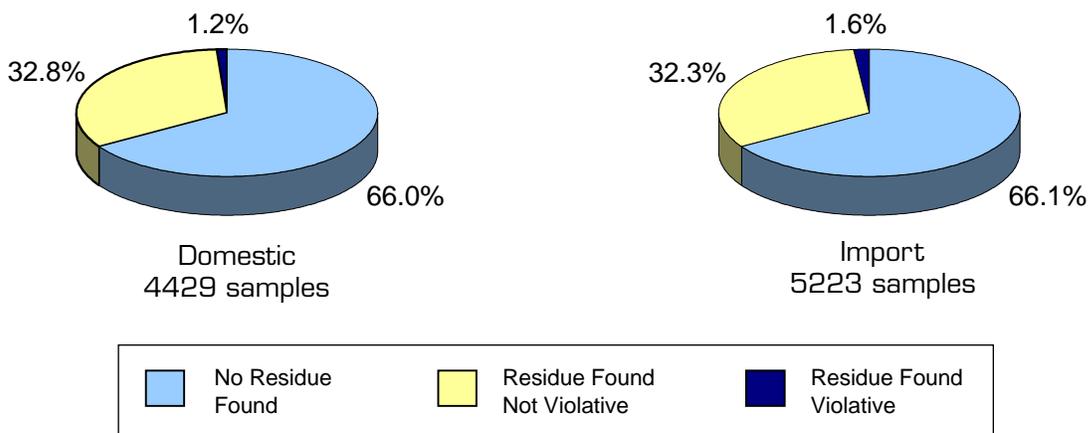
^c DDE/DDT/TDE, n=4; pirimiphos-methyl, lindane, and tris(chloropropyl)phosphate, n=3 each; ethoxyquin and Gardona, n=2 each; chlordane, dieldrin, diphenyl 2-ethylhexyl phosphate, endosulfan sulfate, methamidophos, permethrin, phosmet, quitozene and tri-allate, n=1 each.

^d the 235.0 ppm value was ethoxyquin in brewer's grain. Ethoxyquin is approved as a pesticide (plant regulator) at levels up to 3 ppm (40 CFR 180.178). Ethoxyquin is also a feed additive (anti-oxidant) that is approved at levels up to 150 ppm in a finished article (21 CFR 573.380). Levels above 150 ppm are allowed in individual components of the diet provided the directions for use ensure the proper concentration in the finished article. The next highest value within the range for "all others" was 1.48 ppm.

Summary: Regulatory Monitoring

In summary, no residues were found in 66% of both domestic and import surveillance samples (Figure 3) analyzed under FDA’s regulatory monitoring approach in 1997. Only 1.2% of domestic and 1.6% of import surveillance samples had residue levels that were violative. The findings for 1997 demonstrate that pesticide residue levels in foods are generally well below EPA tolerances, corroborating results presented in earlier reports (4a, 4b). Animal feed samples (460 domestic, 42 import) were analyzed. Over 62% of the domestic surveillance samples and over 52% of the import surveillance samples contained no residues.

Figure 3. Summary of Results of Domestic vs. Import Surveillance Samples



Total Diet Study

The Total Diet Study (TDS) is unique in that it determines pesticide residues in foods prepared for consumption (3). Of the nearly 200 chemicals that are validated for the analytical methods used, 104 individual residues were found in the foods analyzed in the four collections reported here (Market Baskets 96-3, 96-4, 97-1, and 97-2). Among these were 53 pesticides, including 13 which represent more than one related compound counted as a "total", 18 volatile organic compounds for which TDS foods are now being examined, and 10 other organic compounds. To measure the low levels of pesticides found in the TDS foods, the analytical methods used are modified to permit measurement at levels 5-10 times lower than those normally used in regulatory monitoring. In general, residues present at or above 1 part per billion can be measured.

Table 7 lists the 23 most frequently found residues (those found in >2% of the samples), the total number of findings, and the percent occurrence in the four market baskets analyzed in 1997(1036 food items). The three most frequently observed chemicals, DDT, chlorpyrifos-methyl, and malathion, are the same

Table 7. Frequency of Occurrence of Pesticide Residues Found in Total Diet Study Foods in 1997^a

<u>Pesticide^b</u>	<u>Total No. of Findings</u>	<u>Occurrence, %</u>
DDT	244	24
chlorpyrifos-methyl	165	16
malathion	161	16
endosulfan	147	14
dieldrin	127	12
chlorpropham	85	8
chlorpyrifos	79	8
iprodione	62	6
permethrin	45	4
thiabendazole ^c	36	3
dicloran	35	3
methamidophos	31	3
carbaryl ^d	30	2.9
dimethoate	29	2.8
hexachlorobenzene	27	2.6
methoxychlor	26	2.5
BHC (alpha+beta+delta)	24	2.3
pirimiphos-methyl	24	2.3
lindane	23	2.2
acephate	21	2.0
azinphos-methyl	21	2.0
omethoate	21	2.0
toxaphene	21	2.0

^a Based on 4 market baskets analyzed in 1997 consisting of 259 items each (1036 total). Only those found in >2% of the samples are shown.

^b Isomers, metabolites, and related compounds are not listed separately; they are covered under the "parent" pesticide from which they arise.

^c Reflects overall incidence; however, only 66 selected foods per market basket (i.e., 264 items total) were analyzed for the benzimidazole fungicides thiabendazole and benomyl.

^d Reflects overall incidence; however, only 94 selected foods per market basket (i.e., 376 items total) were analyzed for N- methylcarbamates.

as those observed for the past several years. The levels of these pesticides, as well as the others listed in Table 7, were well below regulatory limits.

Information obtained through the TDS is used to estimate dietary intakes of pesticides; these intakes are then compared with established standards. Food consumption data to be used in estimating dietary intakes for the revised food list have only recently been finalized. Therefore, dietary intake information for the market baskets collected since 1991 will be reported separately.

For several years, FDA has collected and analyzed a number of baby foods in addition to those covered under TDS. This adjunct to TDS now includes 22 different food items (13 fruit juices or fruits, 4 fruit desserts, 4 grain products, and 1 vegetable). Table 8 lists the 21 pesticide residues found in four collections of these foods (88 samples total) in 1997, the percentage occurrence, and ranges of levels found.

Table 8. Frequency of Occurrence of Pesticide Residues Found in Selected Baby Foods in 1997^a

<u>Pesticide^b</u>	<u>Total No. of Findings</u>	<u>Occurrence, %</u>	<u>Range, ppm</u>
iprodione	19	22	0.0007–0.073
permethrin	12	14	0.0011–0.072
chlorpyrifos	11	13	0.0003–0.006
endosulfan	11	13	0.0004–0.0145
malathion	9	10	0.001–0.035
carbaryl ^c	8	9	0.004–0.025
chlorpyrifos-methyl	7	8	0.001–0.032
dimethoate	7	8	0.0008–0.006
thiabendazole ^d	6	7	0.034–0.329
ethylenethiourea ^e	4	5	0.005–0.010
propargite ^f	4	5	0.021–0.070
benomyl ^d	3	3	0.035–0.055
phosmet	3	3	0.003–0.005
propiconazole	3	3	0.003–0.052
dieldrin	2	2.3	0.0004–0.001
fenarimol	2	2.3	0.0003–0.0008
omethoate	2	2.3	0.003–0.005
dicloran	1	1.1	0.001
heptachlor	1	1.1	0.0005
methoxychlor	1	1.1	0.0003
parathion-methyl	1	1.1	0.001

^a Based on 4 collections consisting of 88 total items.

^b Isomers, metabolites, and related compounds are not listed separately; they are covered under the “parent” pesticide from which they arise.

^c Reflects overall incidence; however, only 16 selected foods per collection (i.e., 64 items total) were analyzed for N- methylcarbamates.

^d Reflects overall incidence; however, only 15 selected items (i.e., 60 items total) were analyzed for the benzimidazole fungicides (thiabendazole and benomyl).

^e Reflects overall incidence; however, only 13 selected items (i.e., 52 items total) were analyzed for ethylenethiourea.

^f Reflects overall incidence; however, only 16 selected foods per collection (i.e., 64 items total) were analyzed for this sulfur-containing compound.

Summary: Total Diet Study

In 1997, the types of pesticide residues found and their frequency of occurrence in TDS were generally consistent with those given in previous FDA reports (4a, 4b). The pesticide residue levels found were well below regulatory standards. An adjunct survey of baby foods in 1991-1997 also provided evidence of only small amounts of pesticide residues in those foods.

Summary

A total of 9,843 samples of domestically produced food and imported food from 97 countries was analyzed for pesticide residues in 1997. Of these, 9,652 were surveillance samples, which are collected when there is no evidence of a pesticide problem. No residues were found in 66% of both domestic surveillance and import surveillance samples. The higher violation rates in the 191 compliance samples reflect the fact that they are collected and analyzed when a pesticide problem is suspected.

FDA collected and analyzed animal feed samples (460 domestic, 42 import) for pesticides. Over 62% of the domestic surveillance samples and over 52% of the import surveillance samples contained no residues.

Most of the Total Diet Study findings for 1997 were generally similar to those found in earlier periods; details of findings will be published separately. An adjunct survey of baby foods in 1991-1997 also provided evidence of only small amounts of pesticide residues in those foods.

This report was compiled through the efforts of the following FDA personnel: Bernadette M. McMahon, Mark S. Wirtz, and Charles H. Parfitt (Division of Pesticides and Industrial Chemicals), Young H. Lee (Division of Programs and Enforcement Policy), Office of Plant and Dairy Foods and Beverages; Sharon A. Macuci (Division of Information Resources Management), Office of Management Systems, Center for Food Safety and Applied Nutrition, Washington, DC., Randall Lovell, Center for Veterinary Medicine, Rockville, MD, Sheila K. Egan and David Graham, Kansas City District, Lenexa, KS.

The database containing the data from which this report was derived is also available from FDA's World Wide Web site, at <http://www.cfsan.fda.gov>. The 1996 report and database are available at the same site. FDA pesticide monitoring data collected under the regulatory monitoring approach in 1992, 1993, 1994, and 1995 are available for purchase on personal computer diskettes from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161 (telephone 703-487-4650); order numbers are: 1992, PB94-500899; 1993, PB94-501681; 1994, PB95-503132; and 1995, PB96-503156.

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Appendix A. Analysis of Domestic Surveillance Samples by Commodity Group in 1997

<u>Commodity Group</u>	<u>Total Samples</u>	<u>Samples without Residues, %</u>	<u>Samples Violative^a, %</u>	<u># over tolerance</u>	<u># no tolerance</u>
A. Grains and Grain Products					
Corn & corn products	32	50.0	0.0		
Oats & oat products	22	77.3	0.0		
Rice & rice products	79	92.4	0.0		
Soybeans & soybean products	18	83.3	0.0		
Wheat & wheat products	198	37.4	0.0		
Other grains & grain products	24	79.2	0.0		
Breakfast cereals	18	94.4	0.0		
Bakery products, crackers, etc.	6	83.3	0.0		
Total	397	59.5	0.0		
B. Milk/Dairy Products/Eggs					
Cheese & cheese products	91	96.7	0.0		
Eggs	138	100.0	0.0		
Milk/cream & milk products	399	96.0	0.0		
Total	628	97.0	0.0		
C. Fish/Shellfish/Other Aquatic Products					
Fish and Fish Products	258	58.1	0.0		
Shellfish & Crustaceans	109	90.8	0.0		
Other Aquatic Animals & Products	2	100.0	0.0		
Total	369	68.0	0.0		
D. Fruits					
Blackberries	6	66.7	0.0		
Blueberries	35	74.3	0.0		
Cranberries	5	20.0	0.0		
Grapes, raisins	26	50.0	0.0		
Raspberries	21	23.8	0.0		
Strawberries	79	15.2	7.6	2	4
Other berries	1	100.0	0.0		
Grapefruit	18	38.9	0.0		
Lemons	13	69.2	0.0		
Oranges	147	38.8	0.7		1
Other citrus fruit	9	22.2	0.0		
Apples	193	34.7	0.5	1	
Pears	88	42.0	3.4		3
Apricots	3	0.0	0.0		
Avocadoes	1	100.0	0.0		
Cherries	62	24.2	0.0		
Nectarines	13	15.4	0.0		
Peaches	161	29.2	1.2	1	1

^a Includes samples with residues over tolerance or action level and samples with residues with no tolerance.

Appendix A. (continued)

<u>Commodity Group</u>	<u>Total Samples</u>	<u>Samples without Residues, %</u>	<u>Samples Violative^a, %</u>	<u># over tolerance</u>	<u># no tolerance</u>
Plums	6	66.7	0.0		
Bananas, plantains	7	42.9	0.0		
Kiwi fruit	3	100.0	0.0		
Mangoes	4	75.0	0.0		
Cantaloupe	64	73.4	1.6		1
Honeydew	9	55.6	0.0		
Watermelon	41	85.4	0.0		
Other melons	4	25.0	0.0		
Apple juice	95	65.3	0.0		
Citrus juice	31	93.5	0.0		
Other fruit juices	10	90.0	0.0		
Fruit jams/jellies/pastes/toppings	16	56.2	0.0		
Total	1171	44.1	1.2		
E. Vegetables					
Corn	89	100.0	0.0		
Mung beans and bean sprouts	4	100.0	0.0		
Peas (green/snow/sugar/sweet)	97	81.4	1.0		1
String beans (green/snap/pole/long)	161	64.6	1.2	1	1
Other beans & peas & products	74	93.2	0.0		
Cucumbers	66	69.7	3.0	1 ^b	1
Eggplant	23	73.9	4.3		1
Okra	2	100.0	0.0		
Peppers, hot	12	50.0	8.3		1
Peppers, sweet	85	57.6	0.0		
Squash/pumpkins	112	74.1	1.8		2
Tomatoes	143	67.8	0.0		
Other fruiting vegetables	2	100.0	0.0		
Artichokes	2	100.0	0.0		
Asparagus	32	100.0	0.0		
Bok choy & Chinese cabbage	19	36.8	21.1		4
Broccoli	23	78.3	0.0		
Cabbage	68	83.8	0.0		
Cauliflower	12	75.0	0.0		
Celery	21	0.0	4.8		1
Collards	17	58.8	11.8	1	1
Endive	11	27.3	27.3		3
Kale	8	50.0	0.0		
Lettuce, head	60	46.7	5.0	2	1
Lettuce, leaf	66	33.3	4.5	1	2
Mustard greens	12	50.0	16.7	1	1

^b Residue in sample exceeded an action level rather than a tolerance.

Appendix A. (continued)

<u>Commodity Group</u>	<u>Total Samples</u>	<u>Samples without Residues, %</u>	<u>Samples Violative^a, %</u>	<u># over tolerance</u>	<u># no tolerance</u>
Spinach	34	35.3	11.8	2	2
Other leaf & stem vegetables	19	84.2	10.5		2
Mushrooms and Truffles	8	75.0	0.0		
Carrots	116	64.7	1.7	1	1
Cassava	1	0.0	0.0		
Onions/leeks/scallions/shallots	32	87.5	0.0		
Potatoes	152	61.2	1.3	2	
Radishes	12	91.7	0.0		
Red beets	18	72.2	11.1		2
Sweet potatoes	33	81.8	3.0	1	
Other root & tuber vegetables	12	83.3	0.0		
Vegetables with sauce	8	100.0	0.0		
Vegetables, dried or paste	28	96.4	3.6		1
Other vegetables/vegetable products	13	69.2	0.0		
Total	1707	69.1	2.4		
F. Other					
Peanuts & peanut products	41	78.0	0.0		
Other nuts & nut products	1	100.0	0.0		
Edible seeds	1	100.0	0.0		
Vegetable oil, crude	10	100.0	0.0		
Vegetable oil, refined	3	100.0	0.0		
Spices & condiments & flavors	11	90.9	0.0		
Beverage bases	23	56.5	0.0		
Honey & other sweeteners	9	88.9	0.0		
Baby foods/formula	51	92.2	0.0		
Other food products, incl. prepared foods	6	66.7	0.0		
Nonfood items	1	100.0	0.0		
Total	157	82.8	0.0		
A-F. Total	4429	66.0	1.2		

Appendix B. Analysis of Import Surveillance Samples by Commodity Group in 1997

<u>Commodity Group</u>	<u>Total Samples</u>	<u>Samples without Residues, %</u>	<u>Samples Violative^a, %</u>	<u># over tolerance</u>	<u># no tolerance</u>
A. Grains and Grain Products					
Corn & corn products	5	80.0	0.0		
Oats & oat products	3	100.0	0.0		
Rice & rice products	88	88.6	0.0		
Soybeans & soybean products	4	100.0	0.0		
Wheat & wheat products	26	73.1	0.0		
Other grains & grain products	24	62.5	12.5		3
Breakfast cereals	9	100.0	0.0		
Bakery products, crackers, etc.	25	84.0	0.0		
Pasta and noodles	138	89.9	0.0		
Total	322	86.0	0.9		
B. Milk/Dairy Products/Eggs					
Butter	1	100.0	0.0		
Cheese & cheese products	61	93.4	0.0		
Eggs	20	75.0	0.0		
Milk/cream & milk products	3	100.0	0.0		
Total	85	89.4	0.0		
C. Fish/Shellfish/Other Aquatic Products					
Fish and Fish Products	128	93.0	0.0		
Shellfish & Crustaceans	26	96.2	0.0		
Other Aquatic Animals & Products	4	100.0	0.0		
Total	158	93.7	0.0		
D. Fruits					
Blackberries	59	32.2	3.4		2
Blueberries	15	60.0	0.0		
Cranberries	4	75.0	0.0		
Grapes, raisins	139	46.8	0.7		1
Raspberries	105	26.7	1.9		2
Strawberries	38	18.4	0.0		
Other berries	7	71.4	0.0		
Clementines	5	20.0	0.0		
Grapefruit	6	100.0	0.0		
Lemons	12	75.0	0.0		
Limes	61	82.0	0.0		
Oranges	46	84.8	0.0		
Other citrus fruit	8	62.5	12.5		1
Apples	58	24.1	1.7		1
Pears	88	43.2	0.0		
Other pome fruit	12	91.7	0.0		

^a Includes samples with residues over tolerance or action level and samples with residues with no tolerance.

Appendix B (continued)

<u>Commodity Group</u>	<u>Total Samples</u>	<u>Samples without Residues, %</u>	<u>Samples Violative^a, %</u>	<u># over tolerance</u>	<u># no tolerance</u>
Apricots	3	33.3	0.0		
Avocadoes	21	100.0	0.0		
Cherries	8	37.5	0.0		
Dates	4	100.0	0.0		
Nectarines	10	50.0	0.0		
Olives	56	87.5	0.0		
Peaches	33	57.6	3.0		1
Plums	15	60.0	0.0		
Other pit fruit	7	71.4	14.3		1
Bananas, plantains	359	55.4	0.0		
Guavas	3	66.7	0.0		
Kiwi fruit	25	64.0	4.0		1
Mangoes	71	91.5	0.0		
Papaya	65	67.7	3.1		2
Pineapple	96	78.1	0.0		
Other sub-tropical fruit	80	87.5	7.5		6
Cantaloupe	80	21.2	1.2		1
Honeydew	75	28.0	5.3		4
Watermelon	45	68.9	0.0		
Other melons	33	36.4	0.0		
Other fruits	7	100.0	0.0		
Apple juice	33	87.9	0.0		
Citrus juice	15	100.0	0.0		
Other fruit juices	93	91.4	1.1		1
Fruit jams/jellies/pastes/toppings	134	88.8	0.8		1
Total	2034	60.6	1.2		
E. Vegetables					
Corn	28	92.9	0.0		
Mung beans and bean sprouts	14	100.0	0.0		
Peas (green/snow/sugar/sweet)	74	64.9	8.1	1	5
String beans (green/snap/pole/long)	83	31.3	8.4	1	6
Other beans & peas & products	89	83.2	2.2	1 ^b	1
Cucumbers	94	35.1	2.1		2
Eggplant	25	48.0	0.0		
Okra	32	87.5	0.0		
Peppers, hot	216	43.1	5.1	2	9
Peppers, sweet	212	59.4	0.5		1
Squash/pumpkins	148	35.1	0.7		1
Tomatoes	325	49.9	0.3		1
Other fruiting vegetables	65	67.7	4.6		3

^b Residue in sample exceeded an action level rather than a tolerance.

Appendix B (continued)

<u>Commodity Group</u>	<u>Total Samples</u>	<u>Samples without Residues, %</u>	<u>Samples Violative^a, %</u>	<u># over tolerance</u>	<u># no tolerance</u>
Artichokes	29	93.1	0.0		
Asparagus	89	92.1	1.1	1	
Bamboo shoots	16	100.0	0.0		
Bok choy & Chinese cabbage	16	62.5	0.0		
Broccoli	43	83.7	0.0		
Cabbage	15	66.7	0.0		
Cauliflower	8	75.0	0.0		
Celery	14	28.6	0.0		
Endive	4	100.0	0.0		
Kale	15	46.7	6.7		1
Lettuce, head	12	41.7	0.0		
Lettuce, leaf	27	55.6	0.0		
Mustard greens	2	50.0	0.0		
Radicchio	9	100.0	0.0		
Spinach	20	50.0	0.0		
Other leaf & stem vegetables	66	59.1	1.5		1
Mushrooms and Truffles	68	95.6	0.0		
Carrots	49	75.5	2.0		1
Cassava	24	100.0	0.0		
Onions/leeks/scallions/shallots	75	73.3	1.3		1
Potatoes	20	95.0	0.0		
Radishes	9	44.4	0.0		
Red beets	9	44.4	0.0		
Sweet potatoes	22	95.5	0.0		
Water chestnuts	34	97.1	2.9		1
Other root & tuber vegetables	43	86.0	4.7		2
Vegetables with sauce	14	85.7	0.0		
Vegetables, dried or paste	145	77.2	5.5	3 ^b	5
Other vegetables/vegetable products	54	79.6	0.0		
Total	2356	63.0	2.1		
F. Other					
Almonds & almond products	1	100.0	0.0		
Cashews	25	92.0	0.0		
Coconut & coconut products	15	100.0	0.0		
Peanuts & peanut products	23	65.2	0.0		
Other nuts & nut products	23	95.7	0.0		
Edible seeds	17	82.3	17.6		3
Vegetable oil, crude	5	60.0	0.0		
Vegetable oil, refined	14	100.0	0.0		
Spices & condiments & flavors	23	69.6	13.0		3
Beverages & water	28	100.0	0.0		
Beverage bases	25	92.0	4.0		1
Coffee/tea/wine	3	66.7	0.0		

Appendix B (continued)

<u>Commodity Group</u>	<u>Total Samples</u>	<u>Samples without Residues, %</u>	<u>Samples Violative^a, %</u>	<u># over tolerance</u>	<u># no tolerance</u>
Cocoa beans & chocolate products	4	100.0	0.0		
Honey & other sweeteners	35	88.6	0.0		
Baby foods/formula	1	0.0	0.0		
Other food products, incl. prepared foods	17	94.1	0.0		
Nonfood items	9	55.6	0.0		
Total	268	86.6	2.6		
<i>A-F. Total</i>	<i>5223</i>	<i>66.0</i>	<i>1.6</i>		